

# **Delaware Resilient and Sustainable Communities League Summit**

**November 27, 2017**

## **National Weather Service Efforts to Provide Improved Storm Surge Forecasts**

**Al Cope**

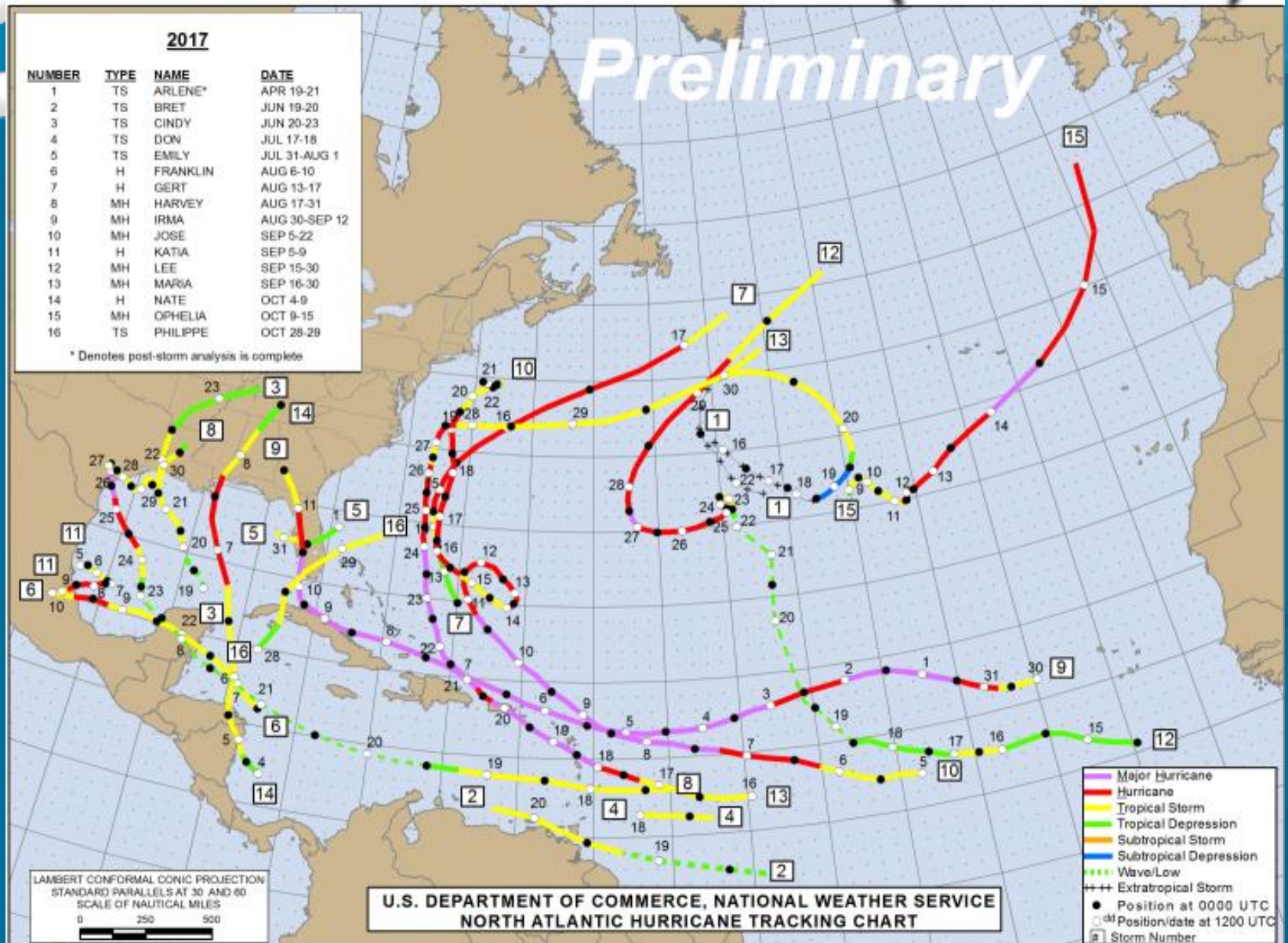
**Science and Operations Officer**

**National Weather Service Forecast Office**

**Mount Holly, NJ**

**[www.weather.gov/phi](http://www.weather.gov/phi)**

# Hurricane Season 2017 (Jun – Nov)



# U.S. Land-falling Storms 2017

*Cindy - Tropical Storm*

*Emily – Tropical Storm*

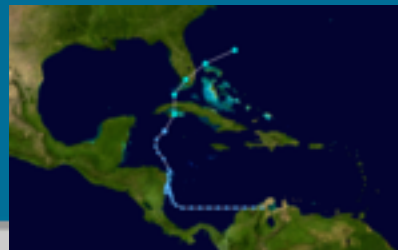
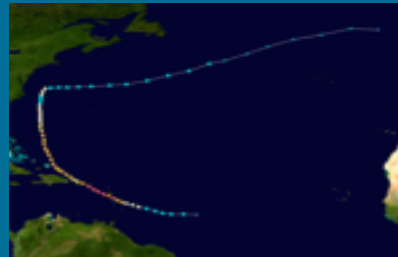
*Harvey – Hurricane Cat 4*

*Irma – Hurricane Cat 4*

*Maria – Hurricane Cat 4*

*Nate – Hurricane Cat 1*

*Phillipe – Tropical Storm*





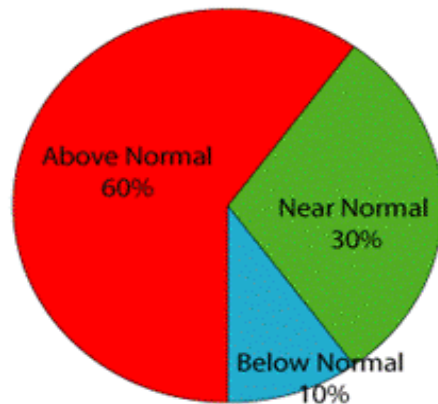
# What was the forecast?

## NOAA's Updated 2017 Atlantic Hurricane Season Outlook

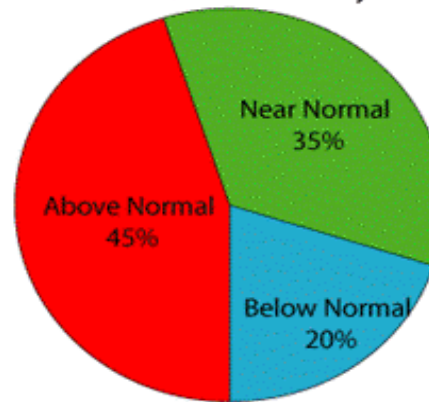
60% Chance of Above-Normal Season, Possibly Extremely Active

### Probability of Season Type

Updated Outlook Issued 9 August



Outlook Issued 25 May



### Predicted Activity

70% Probability For Each Range

	August Update	May Outlook	Season Averages (1981-2010)
Named Storms	14-19	11-17	12
Hurricanes	5-9	5-9	6
Major Hurricanes	2-5	2-4	3
ACE (% median)	100-170%	75-155%	

## Actual Storms:

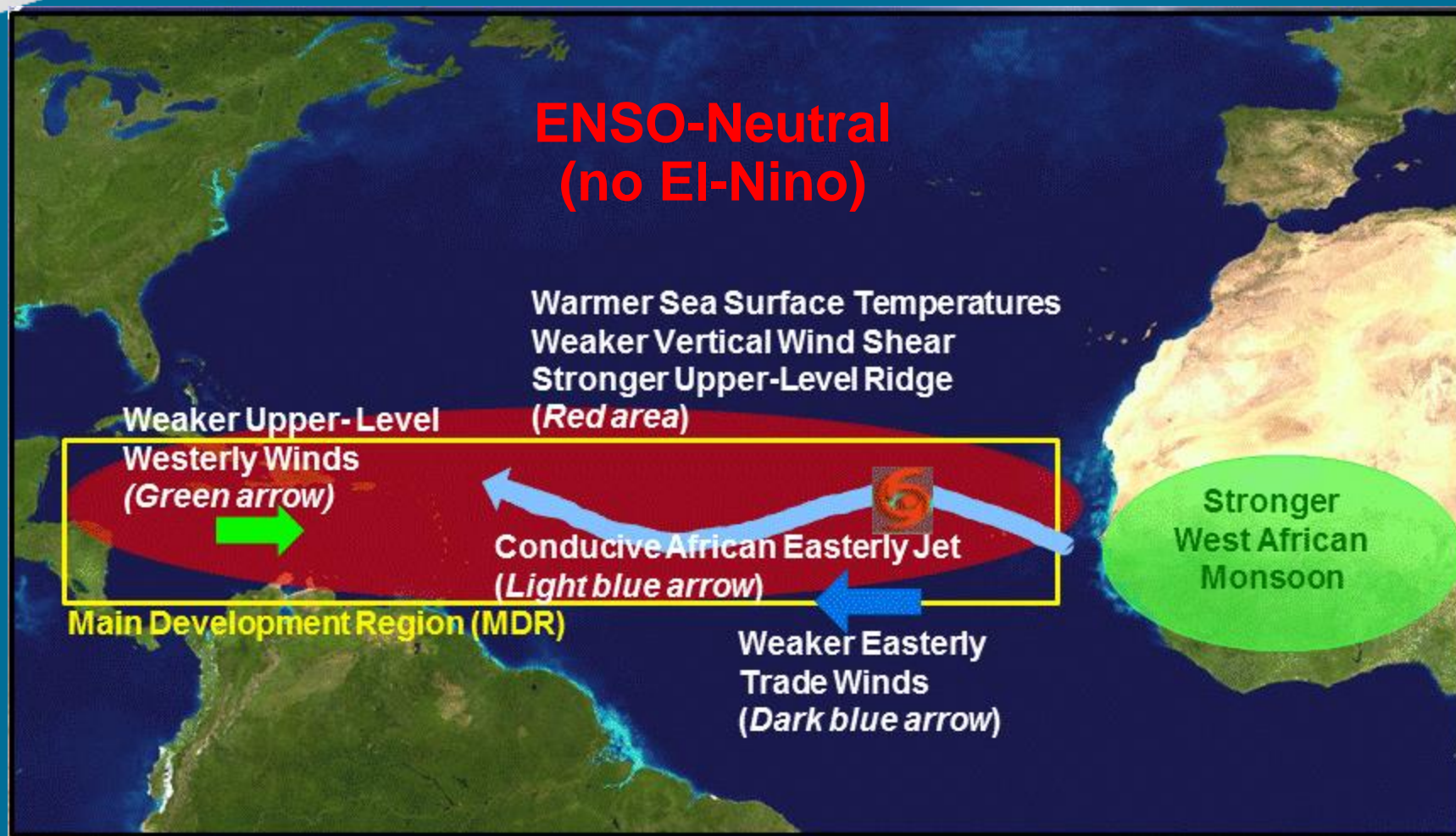
17 Named Storms

10 Hurricanes

6 Major Hurricanes

Graphic courtesy NOAA/Climate Prediction Center

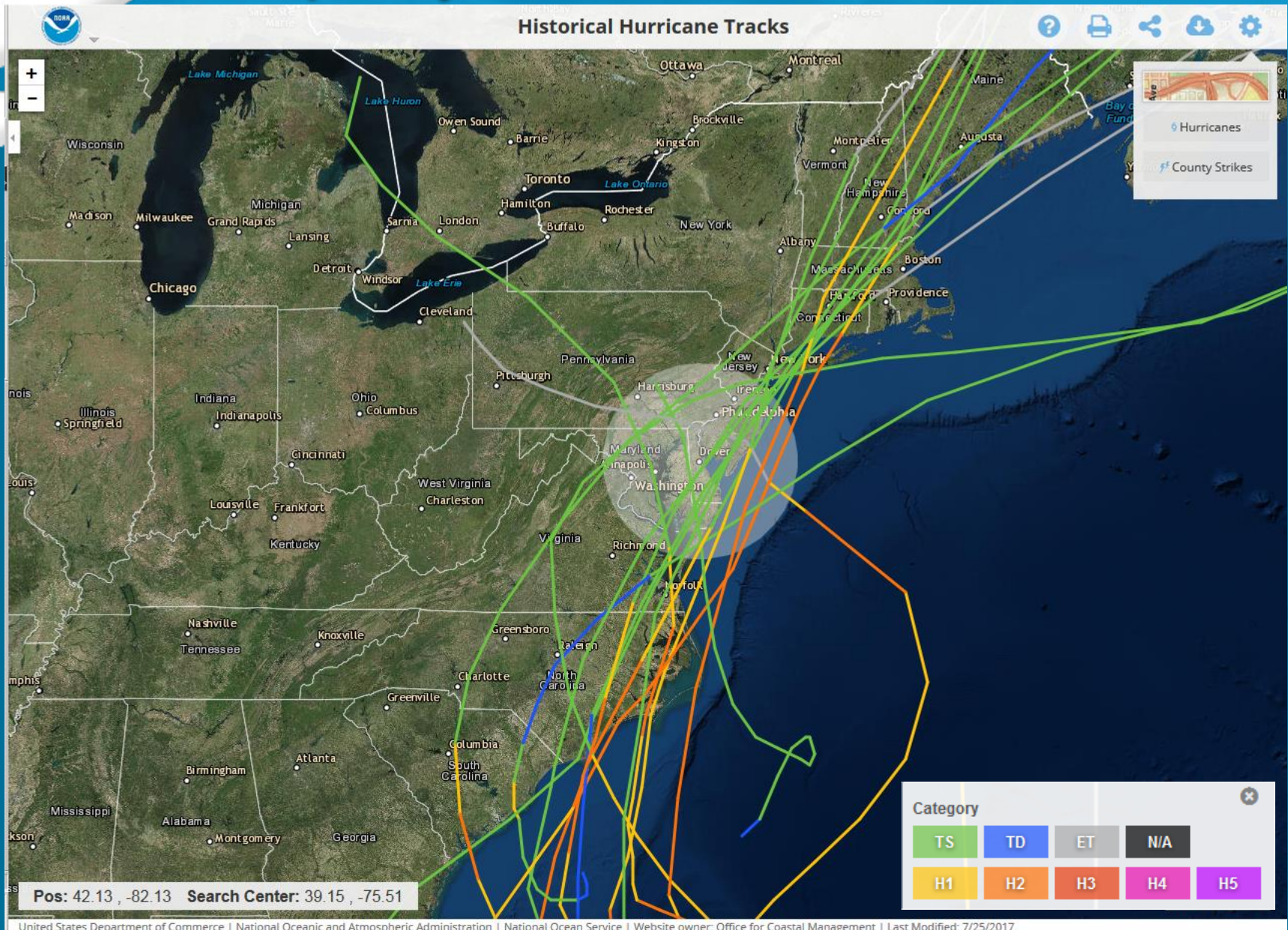
# Expected Conditions During the Peak Months (Aug-Oct) of the 2017 Atlantic Hurricane Season



Graphic courtesy NOAA/Climate Prediction Center

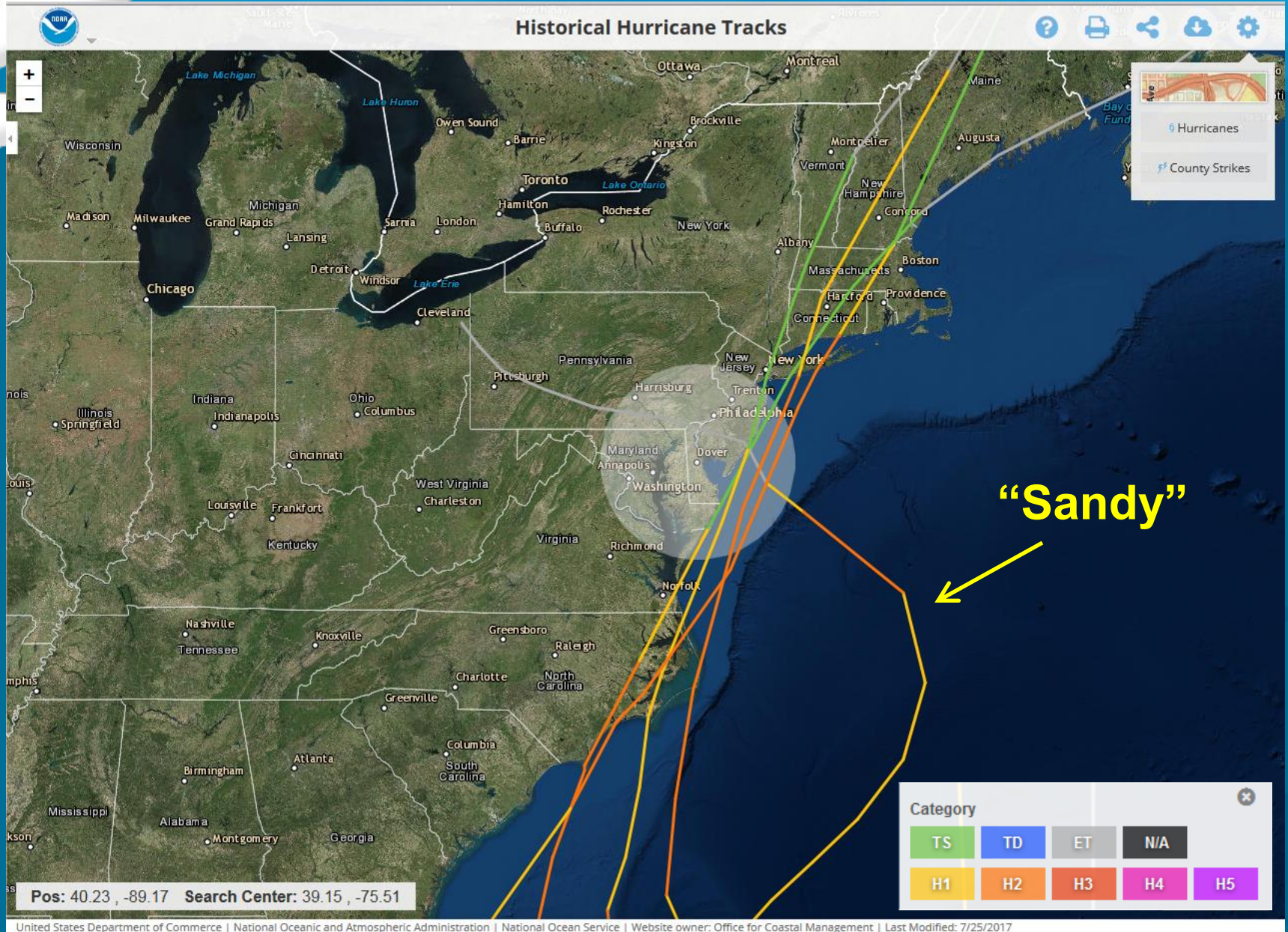


# Tropical Cyclones since 1950 within 100 nm of Dover





# Hurricanes since 1950 within 100 nm of Dover



# Five Toes of the Hurricane Footprint (thanks to Dr. Steve Lyons)

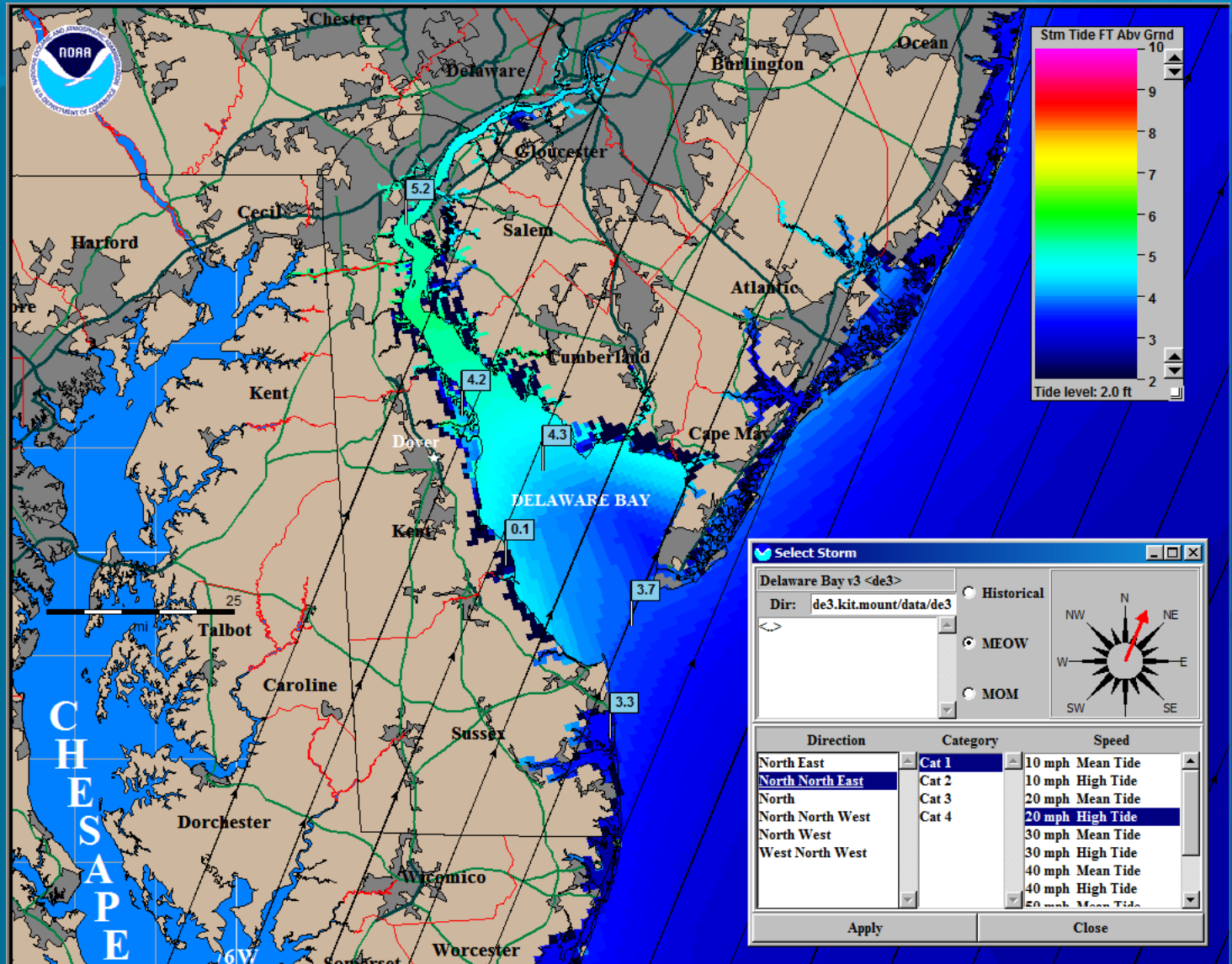
## *Which is the “Big Toe”?*

- Damaging Wind (Maria, 2017)
- Heavy rain and inland flooding (Harvey 2017)
- Storm Surge/Water Rise (Sandy 2012)
- Battering Waves/Beach Erosion
- Tornadoes
- **Every storm is different!**



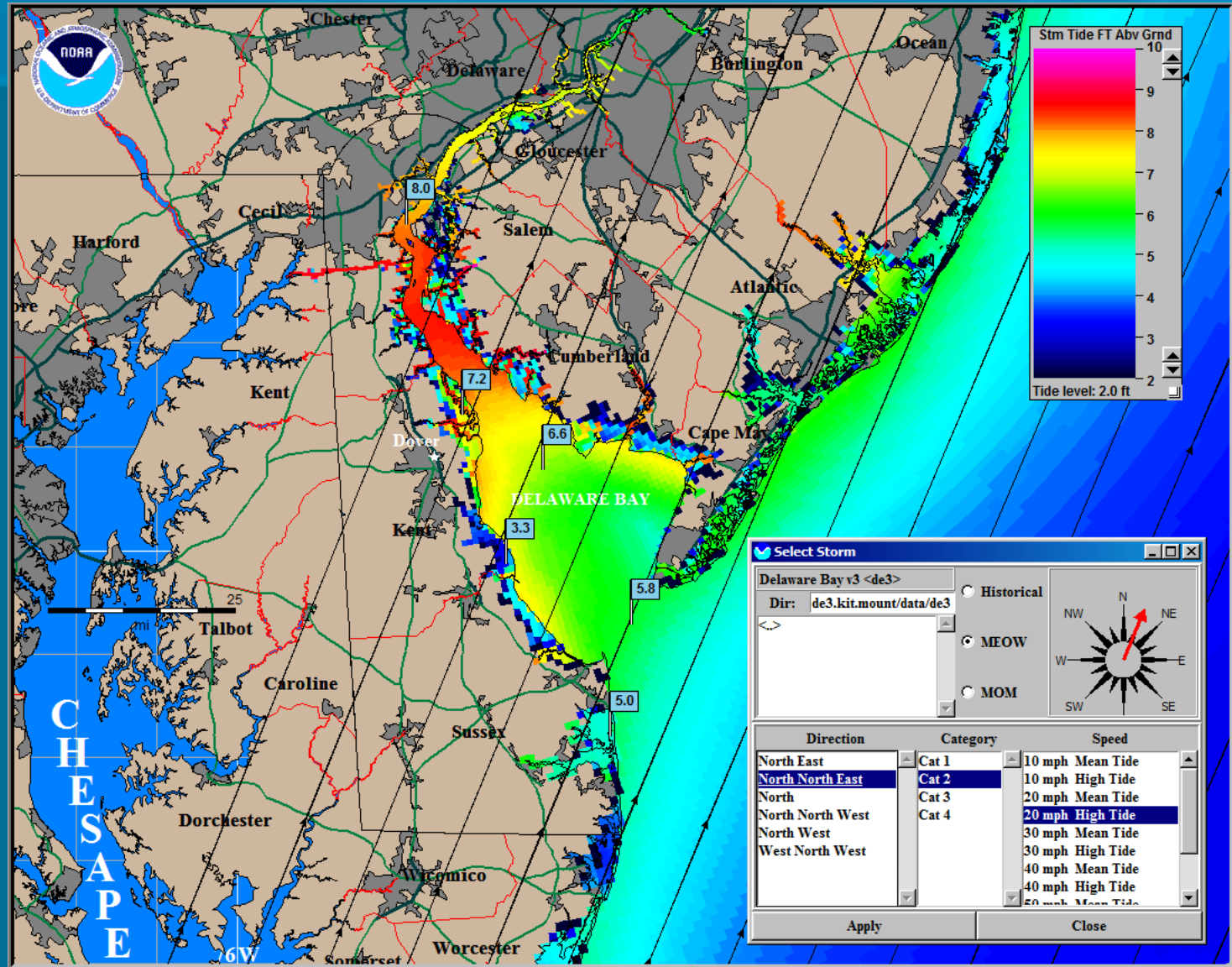
# Maximum Envelope of Water (MEOW): Cat 1 Storm, Moving NNE 20 mph, at High Tide

Results  
from  
Many  
Runs of  
“SLOSH”  
Model



# Maximum Envelope of Water (MEOW): Cat 2 Storm, Moving NNE 20 mph, at High Tide

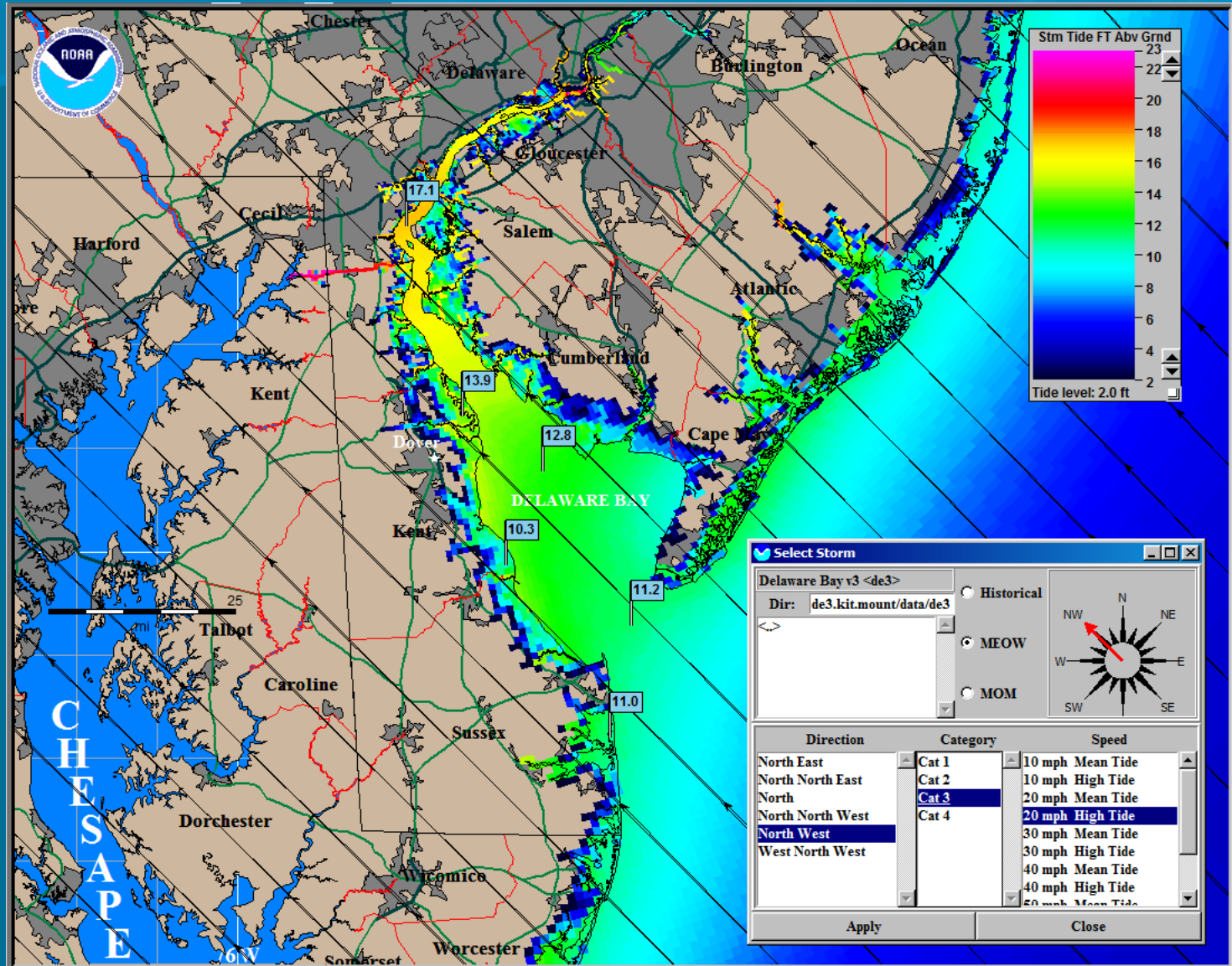
Results  
from  
Many  
Runs of  
“SLOSH”  
Model





# Maximum Envelope of Water (MEOW): Cat 3 Storm, Moving NW 20 mph, at High Tide

Results  
from  
Many  
Runs of  
“SLOSH”  
Model

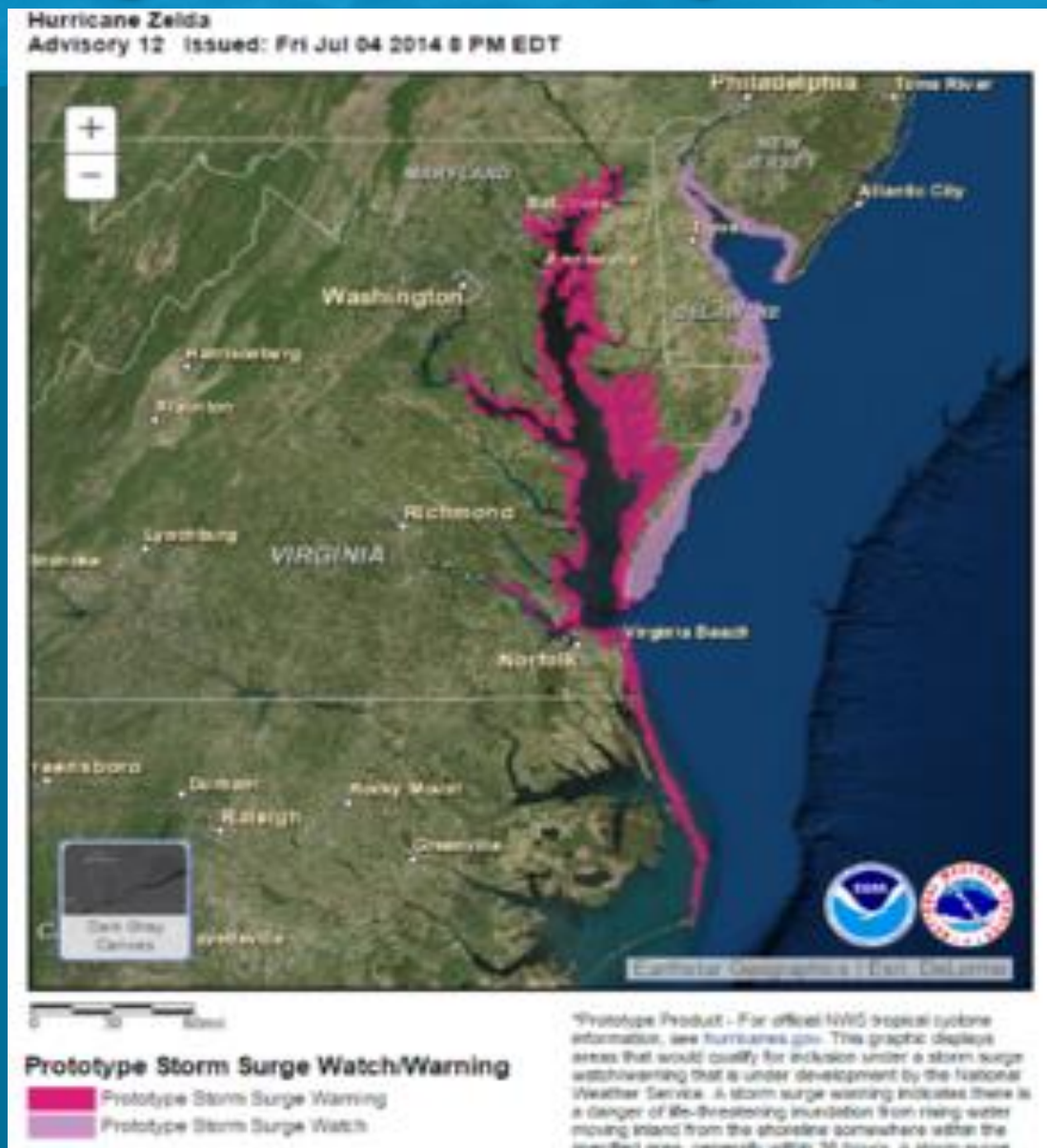


# Storm Surge Watch/Warning Graphic

Issued by NHC, in collaboration with local NWS offices

Areas that have a significant risk of life-threatening inundation (3+ ft)

Normally issued ~48 hours before inundation begins



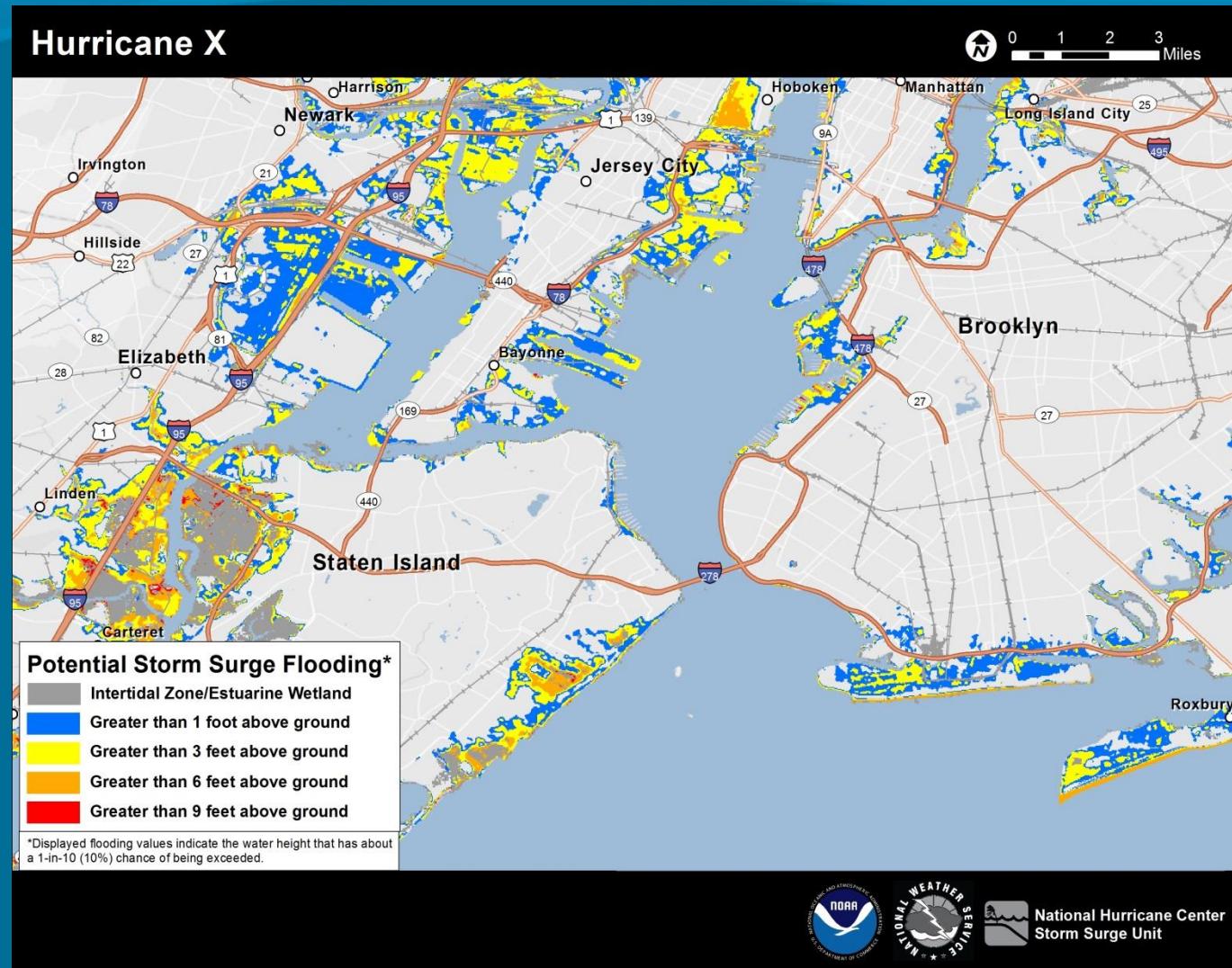


# Potential Storm Surge Flooding Map for New York City

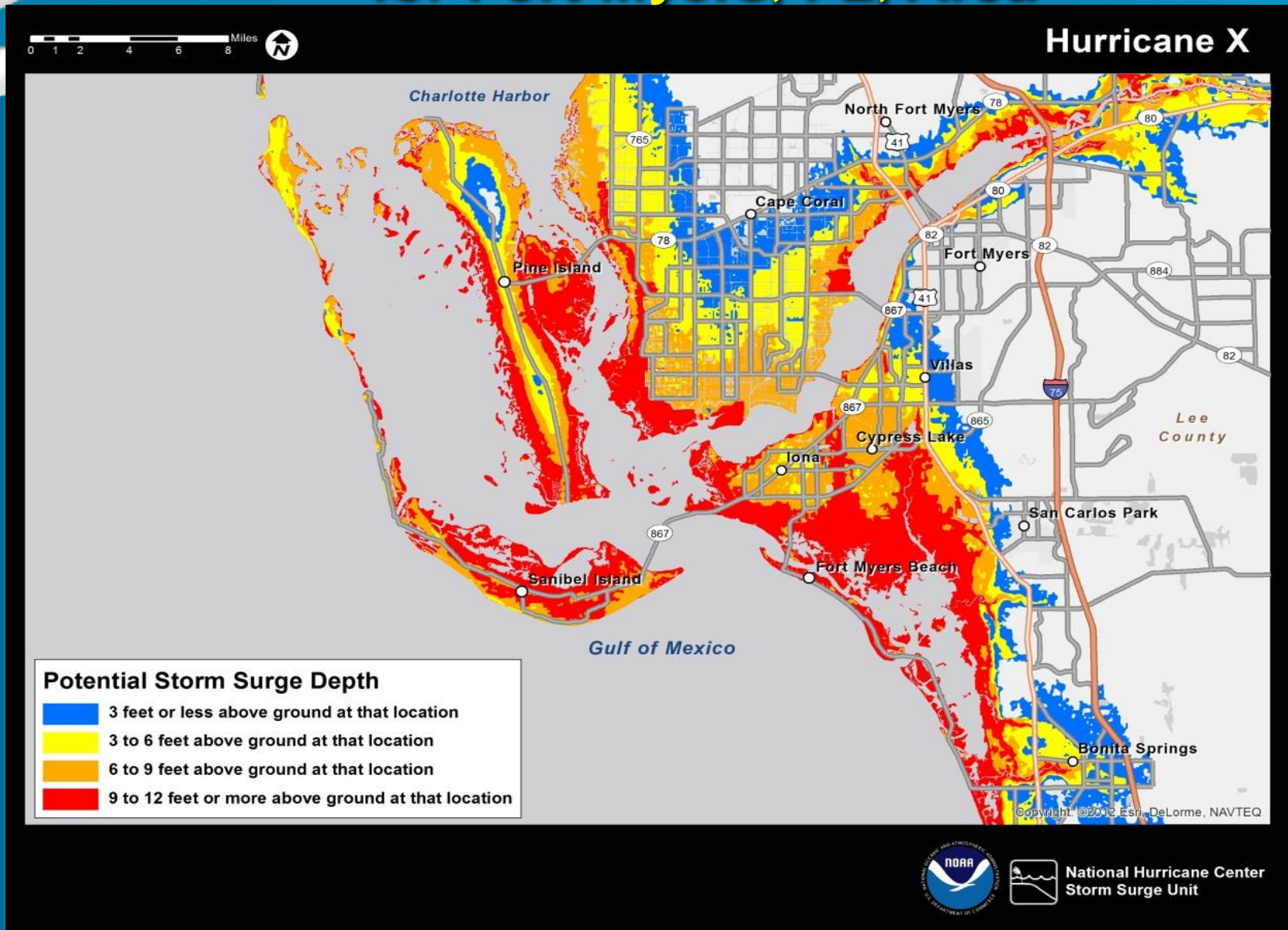
Issued by NHC  
with Hurricane  
Watch in effect

Reasonable  
worst case  
scenario (10%  
exceedance)

Includes tides  
but NOT waves,  
rainfall or river  
flooding.



# Potential Storm Surge Flooding Map for Fort Myers, FL, Area





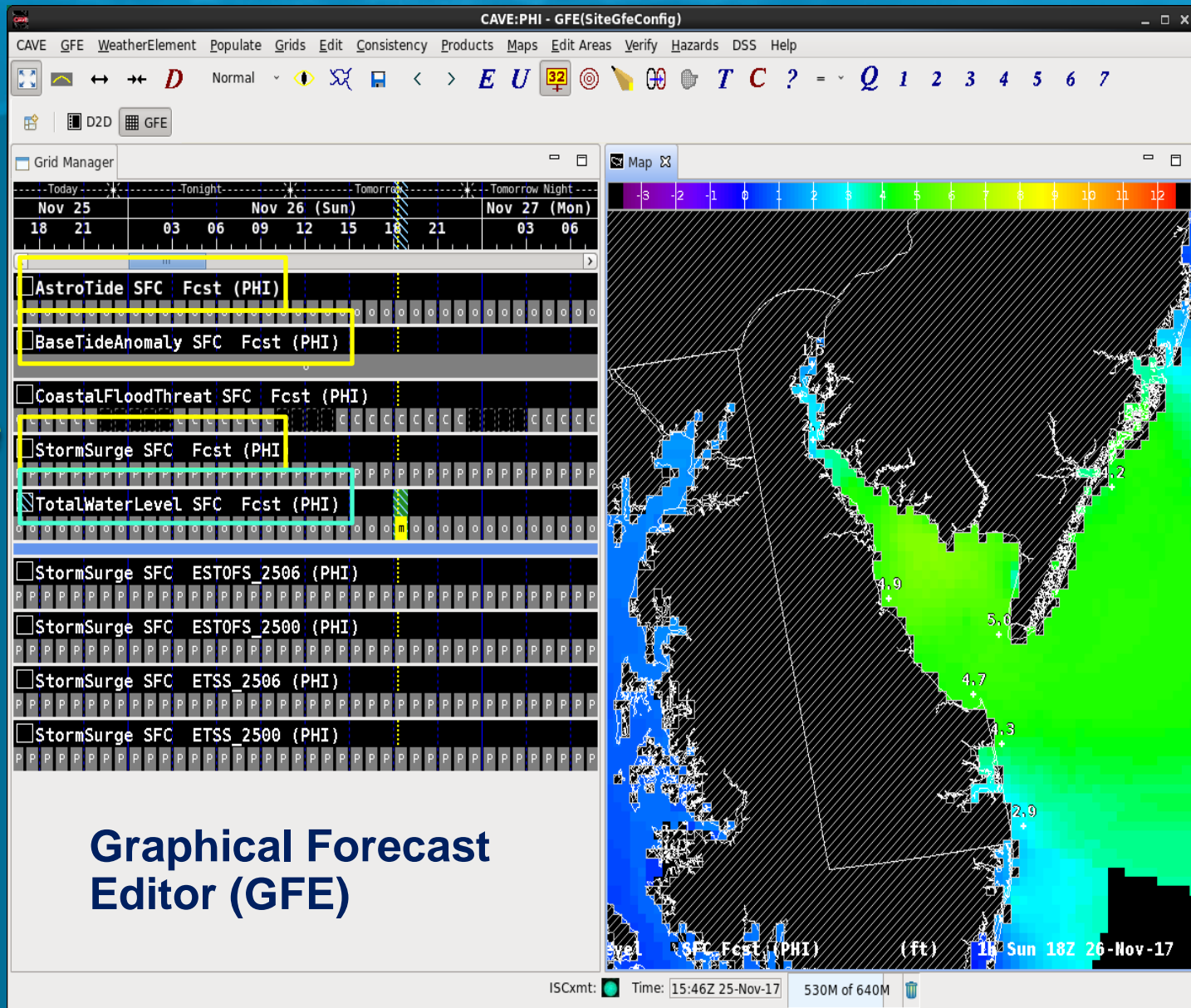
# Computation of Total Water Level

Astronomical  
Tide

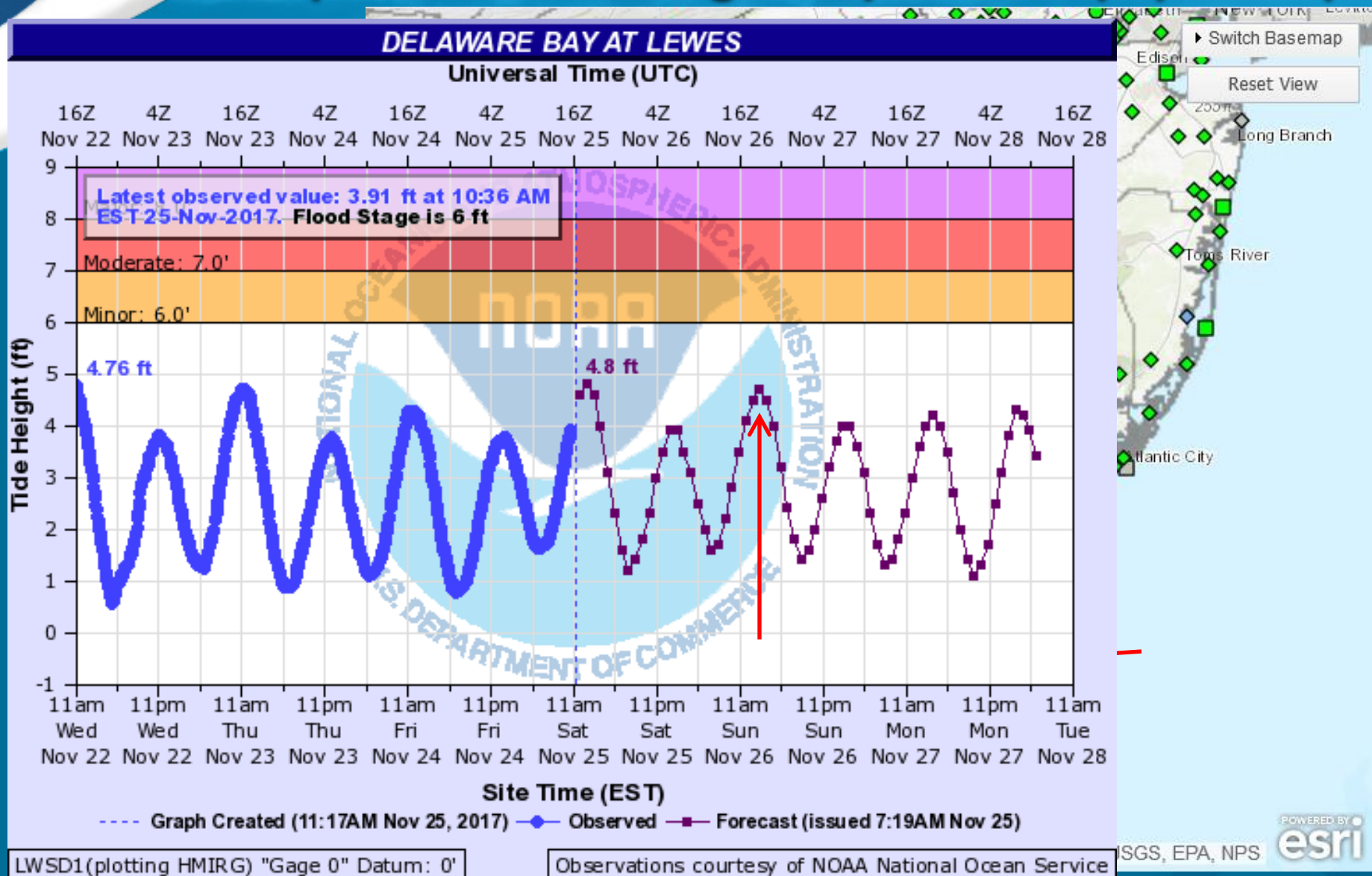
+ Storm Surge

+ Base Tide  
Anomaly

= Total Water  
Level



<http://water.weather.gov/ahps2/index.php?wfo=phi>





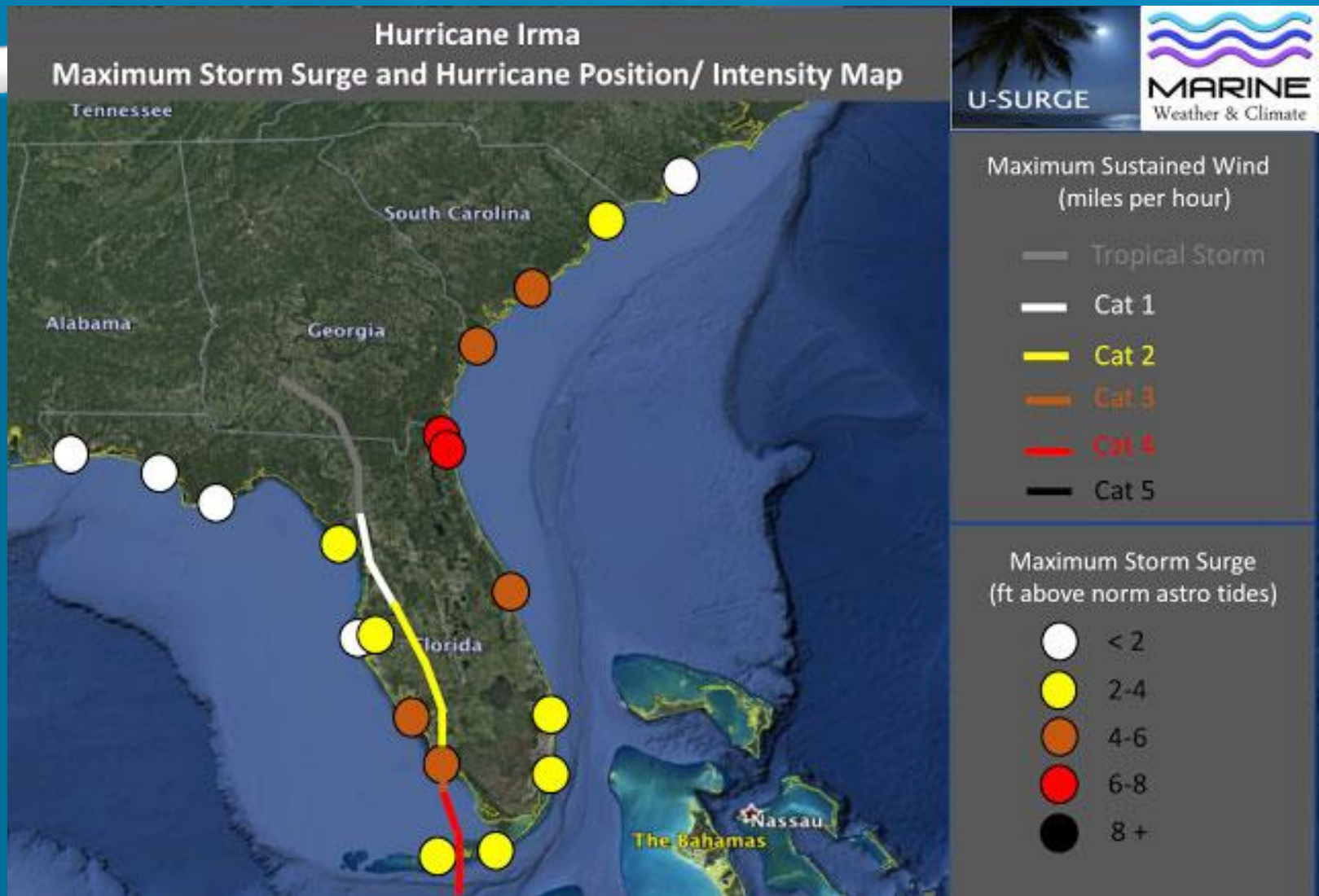
# Main Points

- *Active 2017 Hurricane Season; Three Cat-4 Storms hit the U.S.*
- *NOAA forecast for above-normal activity was correct*
- *SLOSH Model statistics (MEOWs, MOMs) show potential for storm surge in Delaware*
- *NHC now issues storm surge watches/warnings and inundation maps*
- *NWS Mount Holly now issues Total Water Level forecasts for specific locations*

# Extra Slides

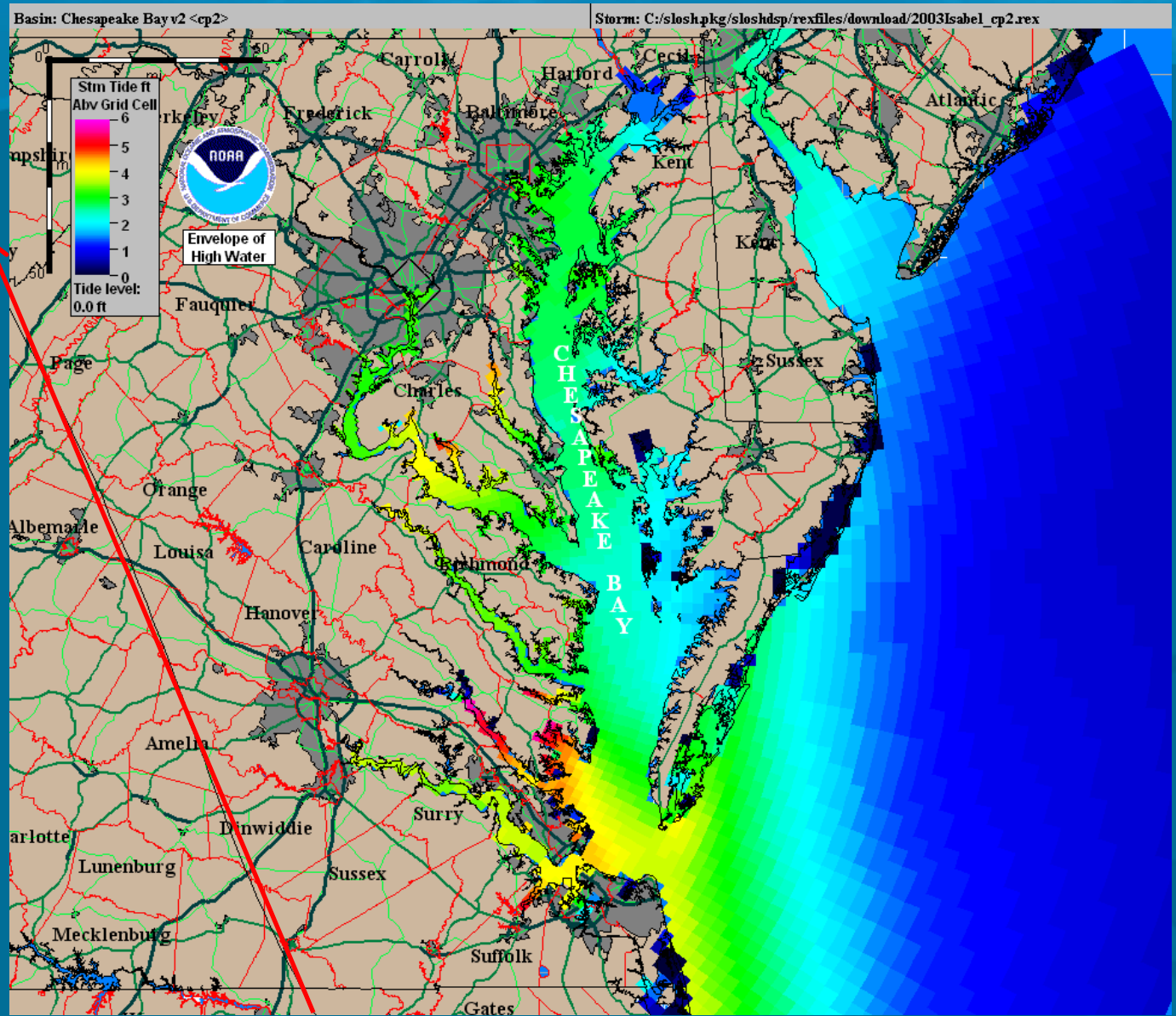


# Maximum Storm Surge – Hurricane Irma



Graphic courtesy Hal Needham/NOAA Tides and Currents

# Storm Surge from Hurricane Isabel 2003





# Maximum of MEOWs (MoM): Cat 4 Storm at HighTide

